DOCUMENT RESUME

ED 061 643 EA 004 251

AUTHOR	Chuang, Ying C.
TITLE	Cost Considerations in Educational Analysis.
PUB DATE	Apr 72
NOTE	11p.; Paper presented at Operations Research Society of America National Meeting (41st, New Orleans, Louisiana, April 1972)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Budgeting; *Cost Effectiveness; Costs; *Expenditures; Federal Programs; Investment; Operations Research; Planning; *Program Effectiveness; Program Evaluation; Programing; Resource Allocations; Speeches; *Systems Analysis
IDENTIFIERS	*Planning Programing Budgeting Systems; PPBS

ABSTRACT

PPBS is a way to improve the methods used in planning, programing, budgeting, and evaluating Federal programs. Careful analysis of proposed expenditures and investments are an explicit part of the PPB system. The process of examining various alternatives in order to assure efficient and effective allocation of resources is known as cost analysis. Cost analysis is concerned with investment decisions, both present and future. This paper presents a concept of cost analysis by starting with a very simple problem in three parts. The basic theory of cost analysis is then explained. Finally, cost analysis is applied to an educational problem. (Author)

COST CONSIDERATIONS IN EDUCATIONAL ANALYSIS

Ying C. Chuang, Ph.D.
Center for Urban Education
105 Madison Avenue
New York, New York 10016

Presentation made at the 41st National Meeting of Operations Research Society of America in New Orleans, Louisiana -- April, 1972

COST CONSIDERATIONS IN EDUCATIONAL ANALYSIS

There is widespread and justifiable interest in developing improved approaches to handling allocation of educational resources associated with major program decision-making processes in the context of educational long-range planning. Systems analysis is one such approach. A systems analysis is a study designed for decision-makers by systematically investigating the relevant objectives in a given problem area and the alternative ways of achieving those objectives. Two important facets of systems analysis are: (1) effective considerations and (2) cost considerations.

In the last few years, effective considerations of systems analysis have already been appplied to education. However, the cost considerations of systems analysis have seldom been applied to educational decision-making processes. This paper presents a concept of cost considerations in education analysis by starting with a very simple problem in three parts. The basic theory of cost analysis is then explained. Finally, cost analysis is applied to an educational problem.

Consider the following hypothetical problem: Two recently developed Community Learning Centers are being considered for an educational R & D function. You are involved in the procurement decision, and you have the information detailed below at your disposal:

- Learning Center Alpha has consumed $100,000. for research and development, while $200,000. has been used for research and development for Learning Center Beta.

- Cost of deploying Alpha would be $425,000., while the cost of Beta would be $400,000.

Assuming that both Learning Centers are equally effective and that all other costs are equal, which Community Learning Center would you recommend for procurement?

Suppose you also have the following additional information at your disposal.

- Expected useful life of each Community Learning Center is six years.
- Operations and maintenance costs for Alpha are estimated at $50,000/year for the first three years; and $100,000/year for the last three.
- Similar Beta costs would be $100,000/year for the first three years; $50,000/year for the last three.
- A 10% discount factor is to represent the "opportunity cost" of our capital.

Assuming all other things to be equal, which would you choose?
(If the discount factor is confusing at this point, ignore it)

There is always more information available than one has time to pursue. You may assume the following additional factors are at your disposal:

- Because of problems associated with poor community system, there is a 40% chance that Alpha will cost $100,000 extra in the first year.
- Because of anticipated equipment replacement requirements, due to shorter life expectancy, there is a 50% chance that Beta will cost $100,000 extra during the sixth year.

Now, for the last time, assuming all other items as being equal, which Community Learning Center would you recommend?

After studying the explanatory material in the following paper, you may wish to try this problem again. In any event, there is a solution for each part of the problem at the end of this paper. The solutions are based on application of cost analysis techniques. However, while there is an "answer" presented for each part of the problem, it must be remembered that cost anlysis is nothing more than a tool to assist the decision makers. Cost analysis identifies, and where possible, quantifies cost implications inherent in decision-making. There are three basic steps in preparation of cost analysis:

(1) Examine all alternatives

(2) Determine costs and benefits of each alternative

(3) Compare cost and benefits of the alternatives

1. Consideration of Alternatives

It so happens that there is only one way to achieve a given goal. Decision-makers can usually choose from a wide variety of alternatives. Clearly, the final decision can be no better than alternatives available to the decision-maker.

2. Determination of Costs and Benefits

Cost-benefit analysis is the process of determining how much an alternative will cost, and what results will be achieved

Costs should be determined for such things as land, labor, materials, research and development.

Benefits are results expected in return for costs incurred. In this case, the word "benefits" is used synonymously with performance, results, utility or output.

It is frequently much more difficult to identify benefits than it is to develop cost information. However, if it is at all possible, benefits or results should be quantified to make this sort of information more useful for the decision maker.

Both costs and benefits should be determined for the entire useful life of the project, that is, from initial development thru the final year in which costs or benefits occur.

3. Comparison of Alternatives

Cost-benefits analysis is the process of comparing costs and benefits of two or more approaches.

If the alternatives considered produce equal benefits, cost-benefits analysis will aid in determining the least cost by alternatives.

If the alternatives considered will be of equal cost, cost-benefits analysis will aid in determining the most productive alternatives.

If the alternatives considered are of unequal costs and produce unequal benefits or outputs, a cost-benefits analysis will provide information for comparing costs and benefits.

There are a number of analytical tools and specific techniques that are used in cost analysis. Some of the most useful include:

> Present Value (discounting) - is a computational technique that accounts for the fact that money to be paid in the future yields investment return until the point in time when it is actually spent.

Break-even Analysis - is a quantitative approach for determining the cost of various spending options. Cost analysis includes such items as determination of relevant costs, use of fixed vs. variable costs, and application of break-even analysis.

Statistical Analysis - is a variety of techniques that end in decision-making under conditions of risk and uncertainty. These include such items as correlation and regression techniques, decision and game theory, payoff tables, decision trees and expected value table.

Of course there is a wide range of other tools and techniques available to help in the allocation of resources. They include such things as linear programming, critical path method, computer simulation, marginal analysis and management by objectives.

With this brief overview behind us, perhaps we can benefit from a short discussion of the Community Learning Center's problem stated at the beginning of this paper.

The first step in cost analysis, as stated earlier, is to search for alternatives to achieve the stated objectives. The problem involved two alternatives - System Alpha and System Beta. It is assumed that all other alternatives had been eliminated.

The second step is to determine comparable costs and benefits for each alternative. Costs are rather easily determined in this case with the limited data presented in the initial version of the problem. Our cost analysis should be concerned only with relevant costs. These

are costs over which the decision-maker still has a choice. In our example, the research and development costs cannot be recovered and should be ignored. Such sunk costs are not relevant to future decisions. As stated in the problem, the cost of Alpha is $425,000 while the cost of Beta is $400,000. Benefits of the two alternatives were stated as equal.

The third step is to compare alternative cost and benefits so as to identify the most efficient approach. In the highly limited comparison necessitated by the data available in the first part of the problem, it is clear that Beta costs $25,000 less than Alpha. Since benefits were stated as being equal, Beta appears to be the more attractive of the two alternatives.

The second part of the problem, covered on the following page, involves more thorough analysis. In the second part of the problem, the presence of additional data permits use of present value technique, sometimes called "discounting," one of the more powerful tools of cost analysis. The present value technique provides a mechanism for considering the time-related value of the money. If you had a choice of receiving $1,000 today or $1,000 ten years from now, there is little question of your selection. By choosing the today route, and with careful investment, you could increase your $1,000 considerably in ten years. Similarly, if you had the choice of paying for an educational system on the basis of $1,000,000 today, or $1,000,000 ten years from now, it would be economical to buy now and pay later. In the interim, the million could be doing other things or increasing in value by earning interest.

It is possible to construct present value tables to calculate future dollar costs on the basis of the time-value money. The table

below uses the 10% discount factor. Column two lists discount factors to be used for individual future years of the Alpha/Beta operational life cycle. Application of these factors to estimated "cash" cost (column 3 and 5) of the two systems provides the present value (PV) of these costs (columns 4 and 6) for each of the alternatives. (Dollar figures are expressed in thousand).

	YEAR	DIS-COUNT FACTOR MULTI-PLIERS	ALTERNATIVES			
			ALPHA		BETA	
			CASH	PV	CASH	PV
	(1)	(2)	(3)	(4)	(5)	(6)
RESEARCH and DEVELOPMENT		1.0	$425	$425	$400	$400
INSTALLMENT and MAINTENANCE	1	.954	50	47.7	100	95.4
	2	.867	50	43.3	100	86.7
	3	.788	50	39.4	100	78.8
	4	.717	100	71.7	50	35.8
	5	.652	100	65.2	50	32.6
	6	.592	100	59.2	50	29.6
			$875	$751.5	$850	$758.9

After computing present value costs of Alpha and Beta, we can make a more meaningful comparison of the two alternatives. Looking at "cash cost" of the systems, we find that the cost of Alpha exceeds Beta by $25,000. However, it must be remembered that a single check will not be written for operation and maintenance expenses. Payments will be

spread over six years. Looking at the present value (PV) data, Alpha is actually the more economical system (751.5 vs. 758.9), and should be the recommended system.

Moving to the third portion of the problem, introduction of an element of uncertainty makes cost-benefit determination more difficult. Since the problem states a 40% chance of Alpha's needing an additional $100,000, we can assume a .4 probability of increased first-year Alpha costs. This increased Alpha cost probability can be priced at $40,000 (probability factor of .4 x $100,000). PV of this $40,000 is $38,200 ($40,000 x first year .954 discount factor). This brings the PV cost of Alpha to $789.7 (751.5 + 38.2). Similarly, there is a .5 probability of Beta needing an additional $100,000 in the sixth year. PV of this cost probability comes to $29,600 (probability factor of .5 x $100,000 additional cost x sixth year .592 discount factor). This brings the PV cost of Beta to $788.500 (758.9 + 29.6). Using the factors for the two uncertainties, Beta would be recommended on the basis of the cost analysis, since the present value cost is $1,200 less than Alpha.

It should be noted, however, that since the difference in this case is relatively small in terms of the total dollars involved (less than .2%), there would be more than likely non-quantifiable benefits that would make the choice more obvious. An additional point to remember in problems where probabilites are involved is that all assumptions and procedures should be well documented.

The use of cost analysis is an important element in the examination of alternatives available to decision-makers. It is a tool that can be used in allocation of resources to insure distribution in a most

effective manner. A most critical step in cost analysis is the search for alternatives. However, final decisions will be more effective if all alternatives are subject to analysis and evaluation in terms of cost and benefit. Cost analysis does not make decisions. A decision-maker should use the product of a good cost analysis to assist him in seeing aspects of his choice more clearly. The strongest claim that can be made for cost analysis is that it provides visibility to costs and benefits of the various alternatives which decision-makers should consider in formulating program priority.

SELECTED BIBLIOGRAPHY

Carpenter, M. B., and S. A. Haggart, Analysis of Education Programs Within a Program Budgeting System, The Rand Corporation, P-4195, September 1969.

Carpenter, M. B., and S. A. Haggart, Cost-Effectiveness Analysis for Educational Planning, The Rand Corporation, P-4327, March 1970.

Chuang, Ying C., A Cost-Effectiveness Analysis Model for Program Evaluation, paper presentation made at the 38th National Meeting of Operations Research Society of America in Detroit, Mich., October 1970.

Chuang, Ying C., A System for Cost Analysis, paper presentation made at the 1971 meeting of International Federation of Operational Research Society, Washington D.C., April 1971.

Dei Rossi, J. A., "The Program Budget and the Traditional Budget," and "Cost Models and Analysis of Cost," in S. A. Haggart, et al., Program Budgeting for School District Planning: Concepts and Applications, RM-6116-RC, November 1969.

Fisher, G. H. What is Resource Analysis?, The Rand Corporation, P-2688, January 1963.

Fisher, G. H., Cost Considerations in Systems Analysis, American Elsevier Publishing Company, Inc., New York, 1970.

Large, J. P. (ed.), Concepts and Procedures of Cost Analysis, The Rand Corporation, P-3479, November 1966.

The George Washington University, State-Local Finances Project, PPB Note 6: The Role and Nature of Cost Analysis in a PPB System, Washington, D.C., April 1967.